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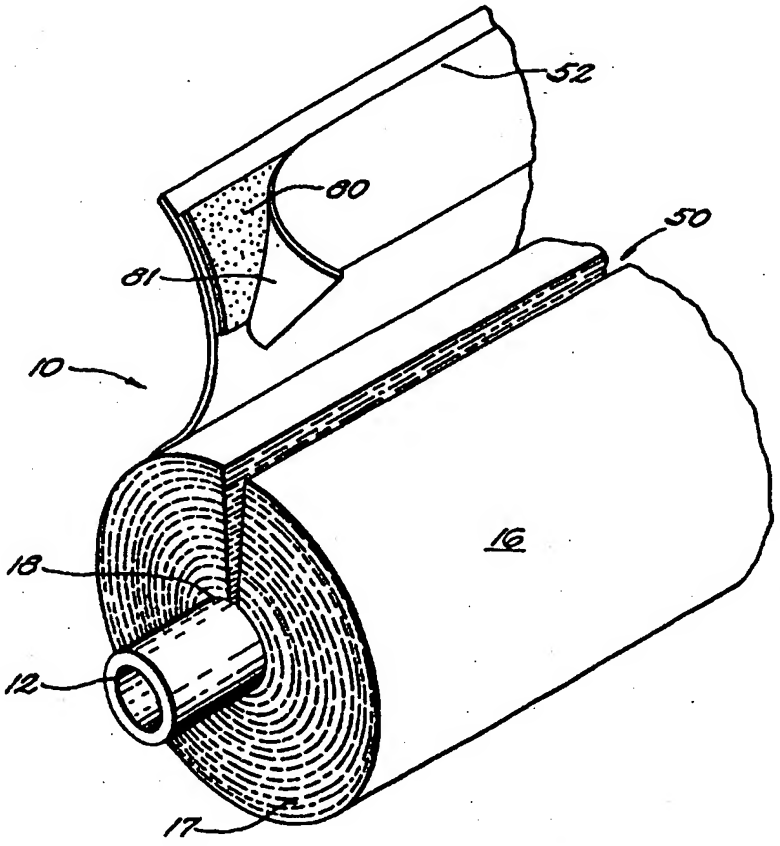
(57) Abstract

An adhesive system for use with a flap of a cylindrical pipe insulation segment. The adhesive system includes a film of a heat sealable adhesive bonded to a layer of a pressure sensitive adhesive which in turn rests on a sheet of release paper coated with a silicon-based release coating.



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PRESSURE SENSITIVE SELF-SEAL LAP FOR INSULATION

FIELD OF THE INVENTION

This invention relates generally to insulation for use with fluid conduits, such as pipes, and more particularly to a pressure sensitive adhesive sealing system for insulating segments for fluid conduits.

BACKGROUND OF THE INVENTION

Pipes which are found in dwellings, commercial buildings or in industrial plants and which carry steam, hot water, cold water, chemicals or petroleum products and the like are often provided with an exterior layer of insulation. Such pipes may be formed of copper, steel, aluminum, plastic, rubber or other like materials. This exterior layer of insulation frequently comprises a fiberglass jacket which is wrapped about the pipe. The insulation also may be formed of a foam material, such as polyethylene, polyvinylchloride or polypropylene. These jackets generally are applied as cylindrical segments which abut one another, end-to-end. Each segment typically comprises a generally cylindrically-shaped block of insulation having a centrally disposed, axially aligned channel adapted to receive the pipe. Each segment also typically comprises an inner, metallized layer, adjacent the pipe and an outer layer or facing formed of paper which typically is a Kraft paper. The facing frequently is formed of a scrim laminated between two paper layers or between a paper layer and a polyester or aluminized polyester layer to produce a textured outer surface. The scrim may also be laminated between two aluminized polyester layers or between a polyester layer and an aluminized polyester layer. The facing may also be formed of polypropylene and aluminum foil laminated together. Each segment typically is slit along its axial length so that the pipe may be inserted into the central channel through the slit.

An overlapping flap is used to draw the two portions of the slit together and to seal the slit. Preferably, the outer edge of this flap is secured to the outer surface of the insulation segment to provide the desired seal. A layer of pressure sensitive adhesive is applied to the undersurface of the flap and is covered with a layer of release paper for protection of the adhesive prior to use. This pressure sensitive adhesive on the underside of the flap usually is applied at the factory, along with the release paper. Typically, such a product includes a first adhesive layer for bonding to the

underside of the flap, a substrate carrier for carrying the adhesive layer, a second adhesive layer which is adapted to bond to the outer surface of the segment, and a layer of release paper for covering the second adhesive layer prior to use. In other applications, the adhesive structure is provided on a roll which can be transferred to the underside of the flap at the job site or at the factory. Under these circumstances, the structure of the adhesive system is the same as that described above, except that a second layer of release paper covers the adhesive layer adapted to be secured to the underside of the flap. This release paper is removed prior to securing the adhesive structure to the flap. In either product, a finger-lift edge can be provided to assist in the removal of the release paper.

While the foregoing existing structures work adequately, it would be desirable to be able to produce a less expensive product which performed in the same manner, but which had fewer layers and which could be produced using fewer manufacturing steps.

SUMMARY OF THE INVENTION

The foregoing and other objects of this invention are achieved in accordance with the method and apparatus of this invention that provides an adhesive structure which is suitable for use in sealing the flap of an insulation segment but which has no substrate and can be manufactured with fewer manufacturing steps.

In the preferred embodiment of this invention, the adhesive structure comprises a layer of a pressure sensitive adhesive coated onto a heat sealable adhesive film. A release paper layer covers the exposed surface of the pressure sensitive adhesive layer not secured to the heat sealable adhesive film. Preferably, the heat sealable film is formed of a hot melt adhesive which is supplied as a clear, dry, non-tacky film.

The process of making this structure includes the step of applying a liquid pressure sensitive adhesive onto a layer of release paper and transporting the liquid adhesive and release paper through a series of thermal curing stations to produce a layer of pressure sensitive adhesive on the release paper. Thereafter, a heat sealable adhesive film is unwound and nipped to the cured pressure sensitive adhesive film at a lamination station. The resulting product is wound onto a master roll.

When the structure is applied to pipe insulation at the factory, the roll of layered adhesive structure is unwound and applied to a layer of insulation facing, typically kraft paper, through heat

assisted nip rollers. The heat sealable adhesive film is heat bonded directly to the insulation facing which serves as the flap for the insulation segments. The combined product is then sent to a pipe insulation wrapping apparatus which rolls the insulation segments, cuts them, and wraps the paper about them. The insulation segments may also be manually rolled, wrapped and cut.

The present invention provides a better bond between the flap and the outer surface of the insulation segment because of the improved bond between the heat sealable adhesive film and the flap. The product is less expensive to produce, since no substrate is required, as the heat sealable adhesive film acts as both the substrate and the adhesive layer which bonds the structure to the underside of the flap. Also, both adhesive layers can be applied in one pass through the coating equipment, while the prior art product requires two passes through the coating equipment.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects, advantages and features of this invention will be more clearly appreciated from the following detailed description, when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a partially cutaway, perspective view of a pipe insulation segment used with the present invention;

Fig. 2 is a cross-sectional side view of a cutaway portion of a prior art adhesive product;

Fig. 3 is a cross-sectional side view of a cutaway portion of an adhesive structure in accordance with this invention;

Fig. 4 is a side schematic view illustrating the manufacturing process of this invention; and

Fig. 5 is a side schematic view illustrating the process of applying the adhesive structure of this invention to the surface of paper used in an insulation segment.

DETAILED DESCRIPTION

With reference now to the drawings, and more particularly to Fig. 1 thereof, the use and application of this invention will be described with particular reference to a cylindrical pipe insulation segment 10. Fig. 1 illustrates a portion of an insulation segment 10 installed about pipe 12. Pipe 12 may be any conventional hot or cold water pipe, steam pipe or pipe for carrying chemicals or petroleum products or the like. Pipe 12 may be formed of any conventional material

such as copper, steel, plastic, aluminum or rubber. Segment 10 typically comprises an outer flame retardant layer 16, a middle insulating layer 17 and an inner metallized layer 18. Typically, layer 16 and metallized layer 18 are secured to opposite sides of layer 17 using a flame resistant laminating adhesive. However, the metallized layer also can be disposed between layer 16 and layer 17. In one embodiment, metallized layer 18 is a layer of aluminum foil, while in another embodiment, metallized layer 18 is an aluminized polyester film. Segment 10 also may have an outer layer of a plastic material such as polyvinylchloride (not shown).

Generally, although not always, layer 16 is formed of a high intensity, white, chemically treated kraft paper, and the weight of the paper is in the order of 30 to 45 pounds per 3,000 square feet. Layer 16 also may comprise a scrim disposed between two paper layers or a paper layer and a polyester layer or between two metallized polyester layers or between a metallized polyester layer and a polyester layer. This combination produces a textured outer surface which has a raised pattern identical to the scrim pattern. Layer 16 also may be formed of polypropylene and aluminum foil laminated together. Layer 17 typically, although not always, is comprised of fiberglass scrim yarns or a mixture of fiberglass and PET yarns, and has a tridimensional 5X5 fiberglass construction. Layer 17 also may be a closed cell foam formed of a material such as polyethylene, polyvinylchloride, or polypropylene. Segment 10 is split along its entire length at slit 50 so that pipe 12 can be inserted into a central channel 12, and slit 50 is adapted to be sealed along its length by a flap 52. Flap 52 typically is an extension of layer 16, or if layers 16 and 18 are laminated together to form a single unit, flap 52 is an extension of the unit formed by layers 16 and 18.

As shown in Fig. 1, an adhesive strip 80 is provided on the undersurface of flap 52 for sealing of flap 52 to the outside surface of layer 16 adjacent to slit 50. Strip 80 extends the entire length of flap 52 and is covered with a layer 81 of release paper prior to sealing of the flap. A typical, prior art adhesive structure 20 for use as strip 80 is illustrated in Fig. 2. Structure 20 includes a substrate 22 which is coated on one side with a conventional pressure sensitive adhesive layer 24 which is adapted to be secured to the underside of flap 52. On the other side of substrate 22 is disposed adhesive layer 26 formed of another pressure sensitive adhesive. Adhesive layer 26 is adapted to secure flap 52 to the outer surface of layer 16 adjacent slit 50. Layers 24 and 26 typically comprise an isooctyl acrylate polymer as described in U.S. Patent No. 4,780,347, or some other like adhesive. Adhesive layer 26 is covered by a layer of release paper 28 which typically comprises a

piece of paper coated with a silicon material which releasably adheres to an acrylic adhesive. Typically, structure 20 is applied to flap 52 at the factory and is present on segment 10 when it arrives at the job site. However, in some instances, it is desirable to apply structure 20 to flap 52 at the job site. In these instances, structure 20 is provided on a roll, and structure 20 includes another layer of a release paper (not shown) covering adhesive layer 24.

A structure 40 of the present invention will now be described with particular reference to Fig. 3. Structure 40 contains no substrate. Rather, structure 40 is comprised of a pressure sensitive adhesive layer 42, a heat sealable adhesive layer 44 disposed on one side of layer 42 and a layer of release paper 46 disposed on the other side of layer 42. Layer 44 typically is a clear, dry, non-tacky film formed of a hot melt adhesive. Layer 44 provides the dual function of a substrate and an adhesive.

In one embodiment, adhesive layer 42 may be a two component, solvent based adhesive system in which the primary component is an acrylic polymerized from monomers such as methyl methacrylate and butyl methacrylate. Suitable solvents include toluene, isopropanol, heptane, hexane, and any other solvent capable of dissolving an acrylic. The solvent content typically is in the range of from about 45% to about 47%, although higher and lower solvent contents are acceptable. Adhesive layer 42 also may include plasticizers and tackifiers to increase the adhesion properties. The viscosity of the adhesive may be in the range of from about 1,000 to about 25,000 centipoise at this solvent content, although a preferred viscosity is in the range of from about 4,000 to about 10,000 centipoise. The peel adhesion of this adhesive when coated at one mil and tested in accordance with PSTC-1 is between about 3.0 and about 3.5 pounds per inch. The Williams plasticity index typically is between about 2.2 and about 2.5 millimeters. An acceptable, commercially available candidate for adhesive layer 42 is an adhesive such as POLYTAC 377 produced by H & N Chemical in Totowa, New Jersey 07512. Another suitable adhesive is an isooctyl acrylate polymer as described in U.S. Patent No. 4,780,347.

Layer 44 may include an adhesive resin from a family comprising an ethylene-acrylic acid copolymer, an ethylene-vinyl acetate copolymer, or a homopolymer such as low density polyethylene. Layer 44 may also be a coextrusion of a polyethylene film and ethylene-vinyl acetate film. Layer 44 preferably comprises a material where the heat activation temperature is about 215°F

or above. Layer 44 typically is about 1 mil in thickness although a film thickness as high as 3 mils is also acceptable. A typical, final coating weight for this heat sealable adhesive is about .793 ounces per square yard. An acceptable, commercially available candidate for this product is an adhesive film such as DAF 899 provided by Dow Chemical Company of Midland, Michigan 48674. Another commercially available candidate for this product is a polyethylene film available from Deerfield Plastics.

The method and apparatus used for formation of structure 40 will now be described with particular reference to Fig. 4. Coating apparatus 120 includes adhesive application station 92, curing ovens 96, corona treatment station 89, lamination station 98, supply roll 107, take-up roll 106 and supply roll 102. Application station 92 typically includes three rollers 93, 95 and 97, and a container 91 with a supply of adhesive 94. Release paper 90 to which adhesive is applied passes around roller 93 and between rollers 93 and 95, which are spaced from one another. Roller 97 remains stationary. Roller 95 picks up adhesive 94 from container 91 and as roller 95 rotates past container 91, adhesive is carried to release paper 90 where the adhesive transfers to the release paper. Typically, roller 95 rotates in the same direction as roller 93, such as in a counterclockwise direction, as shown in Fig. 4, so that the lower surface of roller 95 moves in a direction opposite of paper 90 and the upper surface of roller 93. Stationary roller 97 uniformly meters the amount of adhesive transferred to paper 90 across the entire surface thereof. The spacing between rollers 97 and 95 may be adjusted to adjust the coating weight of the adhesive on the release paper. Alternatively, application station 92 may include a knife (not shown) disposed a fixed distance above roller 95 to meter the adhesive onto paper 90. Application station may also be comprised of a slotted extrusion die configuration (not shown) in which adhesive is forced through a slot in a die and deposited onto paper 90. Curing ovens 96 are conventional electric or gas fired chambers that heat the release paper and adhesive to a predetermined curing temperature. Corona treatment station 89 corona treats the heat sealable adhesive film before it is applied to the adhesive-coated release paper. Lamination station 98 includes rubber coated steel nip rollers 100 which laminate the heat sealable adhesive film to the adhesive on the release paper.

In operation the release paper is provided as a continuous roll 107. Release paper 90 passes between rollers 93 and 95 in application station 92 at which point adhesive 94 is applied to a silicon coated side of paper 90 in the desired coating weights and thicknesses. Alternatively, adhesive may

be metered on with a knife (not shown) or extruded on using a slotted extrusion die (not shown). Typically, the adhesive is applied on an outwardly facing side of paper 90, as shown in Fig. 4. A preferred wet coating weight is about 2.4 ounces per square yard. Adhesive 94 is applied such that it has about a 3.0 mil wet thickness, so that the final, cured coating weight of adhesive layer 94, which later

becomes adhesive layer 42 of Fig. 3, is about 1.2 ounces per square yard and the final cured thickness of layer 94 is about 1.5 mils. Thereafter, the composite comprised of paper 90 and adhesive 94 is passed through curing ovens 96 which heat adhesive 94 to a temperature of about 250°F. Curing ovens 96 vaporize the solvents and cure the adhesive in a known manner. The combined release paper 90 and adhesive 94 composite is then passed through a lamination station 98. At the same time, film 104 formed of a heat sealable adhesive is retrieved from roll 102 and passed through lamination station 98. Film 104 ultimately becomes layer 44 as shown in Fig. 3. Film 104 and the composite formed of release paper 90 and adhesive 94 pass through the nip at rollers 100 such that film 104 is urged into contact with adhesive 94. The pressure produced by rollers 100 activates pressure sensitive adhesive 94 to bind film 104 to adhesive 94. The resulting laminated product is then rolled onto a master roll 106. Typically, release paper 90 is a single sided release paper having a silicon coating on only one side. When the finished product is wound on roll 106, exposed adhesive film 104 does not bind to itself, or to any other part of the finished product, since it is activated only by the application of heat above a specified temperature.

Typically, role 106 is cut into a plurality of rolls of tape 107 of the finished laminate having the desired width. These rolls contain structure 40 of Fig. 3. Normally, structure 40 is applied to segment 10 at the factory. However, it is to be understood, that a roll of tape of structure 40 could be taken to the job site and segments could be manually applied at that location.

The process of applying structure 40 to an insulation segment 10 at the factory will now be described with particular reference to Fig. 5. Initially, layer 16 of segment 10 is provided as a continuous sheet 110 on a roll 112. The side of sheet 110 to be bonded to tape 107 may be formed of metal, polypropylene or polyester. After roll 106 is cut into rolls of tape 107 having the desired width and having the composition of structure 40, tape 107 is unwound from its roll and is advanced toward rollers 114 at the same time as an edge of sheet 110 is advanced. Adhesive film 104 is

placed into contact with one side of sheet 110 along one edge. Tape 107 and an edge of sheet 110 are nipped together through nip rollers 114 which are heated. The combination of the nip pressure of the rollers and the applied heat activates adhesive film 104 to bind film 104 and thus tape 107 to sheet 110 along one edge thereof. This edge of sheet 110 ultimately becomes flap 52 (not shown). Sheet 110 with tape 107 attached to one edge is passed to an insulation wrapping station where sheet 110 is wrapped about insulation, which may be fiberglass or a suitable foam, as described. The wrapping step may either be manual or automated. The wrapped insulation is cut into cylindrical insulation segments in a known manner. The edge of sheet 110 which carries tape 107 is left free to form flap 52.

It will be recognized that the present invention reduces the cost of the adhesive strip 80 disposed on flap 52 on an insulation segment 10 by eliminating substrate 22 and its attendant costs as well as a second layer of adhesive 24 or 26. Moreover, only one pass through the coating equipment is required, while the prior art structure required a second pass through the coating equipment to apply the second layer of adhesive. Finally, the particular adhesive selected bonds more tightly to flap 52 than previously used adhesives.

Modifications and improvements will occur within the scope of this invention to those of ordinary skill in the art, and the above description is intended as exemplary only. The scope of this invention is defined by the following claims and their equivalents.

What is claimed is:

CLAIMS

1. An insulation system for an elongated fluid conduit comprising:

insulation for covering the elongated fluid conduit, said insulation having a slit extending along said insulation in the direction of elongation of the fluid conduit;

an outer layer of material covering said insulation on an exterior surface thereof;

a flap adapted to extend across said slit and seal said slit;

an adhesive layer disposed on said flap for sealing said flap to said outer layer of material, said adhesive layer comprising:

a layer of a heat sealable adhesive bonded to said flap; and

a layer of a pressure sensitive adhesive adhesively bonded to said layer of heat sealable adhesive and adapted to be secured to said outer layer of material upon the application of pressure to said flap against said outer layer of material.

2. The insulation system as recited in claim 1 further comprising a layer of release paper releasably secured to said layer of pressure sensitive adhesive.

3. The insulation system as recited in claim 1 wherein said layer of pressure sensitive adhesive is formed of a cured acrylic adhesive.

4. The insulation system as recited in claim 3 wherein said pressure sensitive adhesive comprises an acrylic polymerized from butyl methacrylate.

5. The insulation system as recited in claim 3 wherein said pressure sensitive adhesive comprises an acrylic polymerized from methyl methacrylate.

6. The insulation system as recited in claim 1 wherein said heat sealable adhesive comprises an ethylene-acrylic acid copolymer.

7. The insulation system as recited in claim 1 wherein said heat sealable adhesive comprises an ethylene-vinyl acetate copolymer.

8. An insulation system comprising:

a layer of insulation;

a first layer of paper having an outer surface and an inner surface adjacent said layer of insulation;

a layer of a pressure sensitive adhesive bonded to said outer surface of said layer of paper;

a second layer of paper; and

a layer of a heat sealable adhesive disposed between said second paper layer and said layer of pressure sensitive adhesive and bonding said second paper layer to said layer of pressure sensitive adhesive.

9. An adhesive system as recited in claim 8 wherein said pressure sensitive adhesive is formed of a cured acrylic adhesive.

10. The adhesive system as recited in claim 8 wherein said heat sealable adhesive comprises an ethylene-acrylic acid copolymer.

11. The adhesive system as recited in claim 8 wherein said heat sealable adhesive comprises an ethylene-vinyl acetate copolymer.

12. A method for forming an adhesive system comprising the steps of:

supplying a strip of a paper carrier coated with a silicon-based, release coating on at least one side;

applying a liquid pressure sensitive adhesive to the one side of the paper carrier;

heating the liquid adhesive while resident in on the paper carrier to cure the adhesive;

providing a film of a heat sealable adhesive;

applying the heat sealable adhesive film to the cured pressure sensitive adhesive; and

subjecting the heat sealable adhesive film and the cured pressure sensitive adhesive to pressure to bond the heat sealable adhesive film to the cured pressure sensitive adhesive to form a composite structure.

13. The method as recited in claim 12 further comprising the steps of:

placing a layer of paper on the heat sealable adhesive film of the composite structure;

applying pressure and heat to the layer of paper against the composite to activate the heat sealable adhesive film to bond the heat sealable adhesive film to the layer of paper.

14. An adhesive system comprising:

a layer of release paper having a silicon-based release coating on at least one side thereof;

a layer of a pressure sensitive adhesive disposed on said one side of said layer of release paper; and

a layer of a non-tacky heat sealable adhesive film bonded by application of pressure to said layer of pressure sensitive adhesive.

15. The adhesive system as recited in claim 14 wherein said pressure sensitive adhesive is a cured acrylic adhesive.

16. The adhesive system as recited in claim 15 wherein said pressure sensitive adhesive comprises an acrylic polymerized from methyl methacrylate.

17. The adhesive system as recited in claim 15 wherein said pressure sensitive adhesive comprises an acrylic polymerized from butyl methacrylate.

18. The adhesive system as recited in claim 14 wherein said heat sealable adhesive comprises an ethylene-vinyl acetate copolymer.

19. The adhesive system as recited in claim 14 wherein said heat sealable adhesive comprises an ethylene-acrylic acid copolymer.

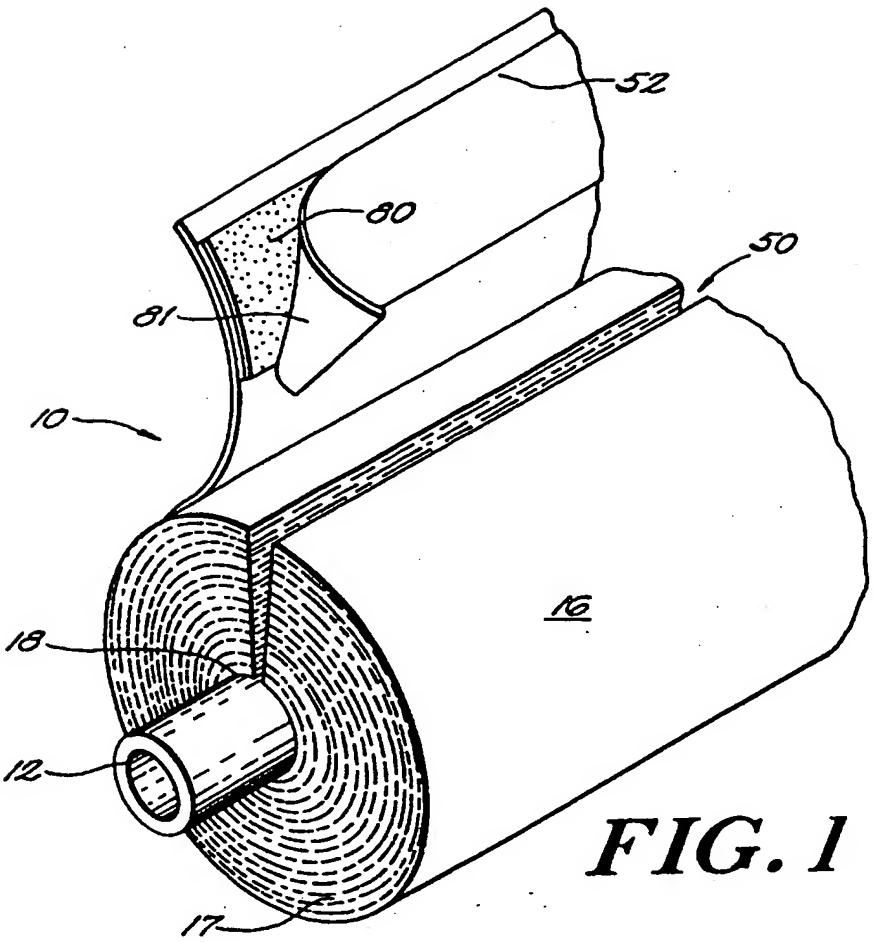

FIG. 1

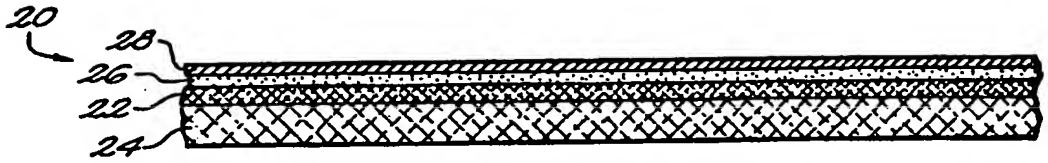

FIG. 2
(PRIOR ART)

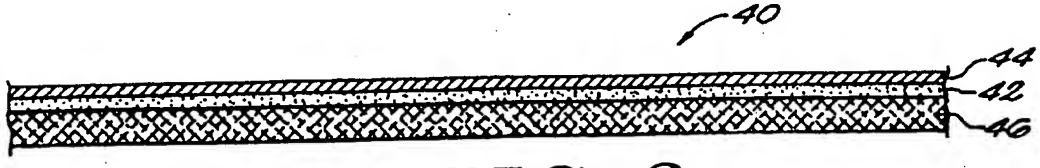

FIG. 3

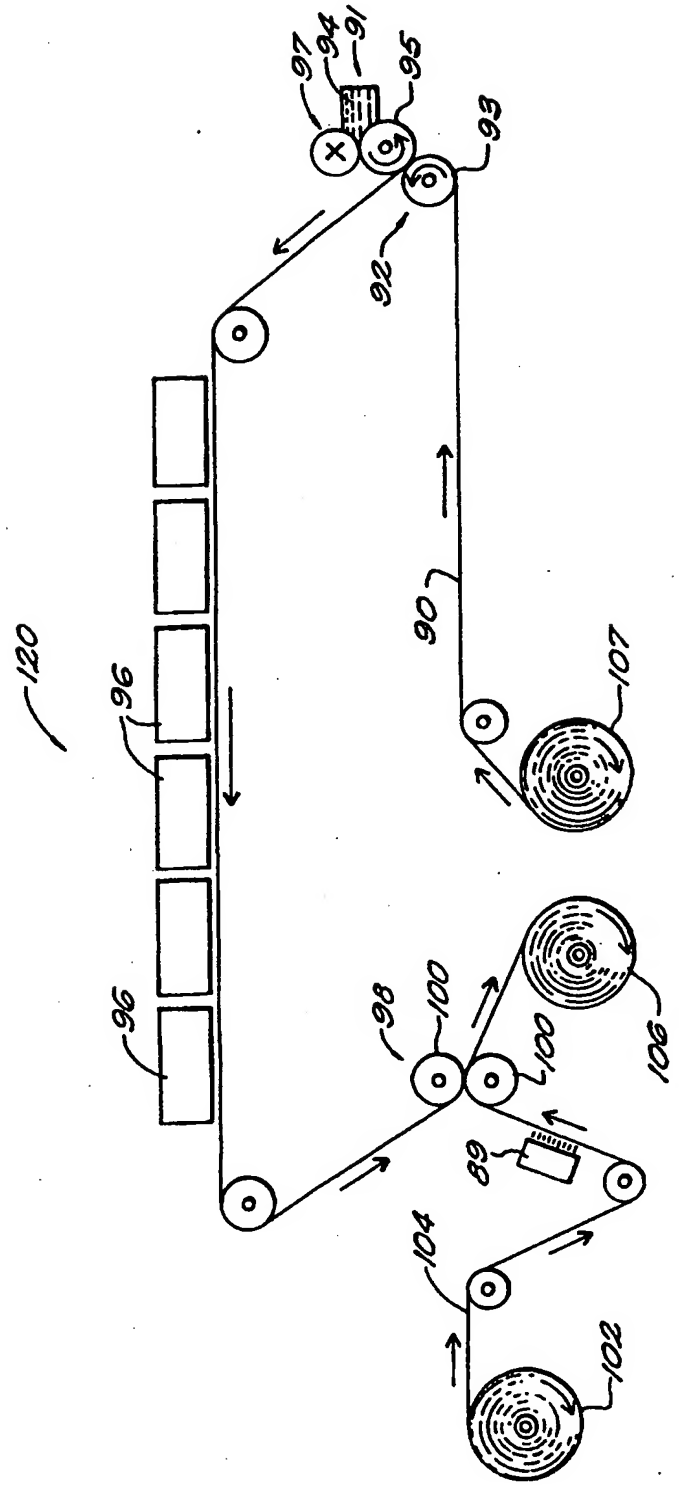

FIG. 4

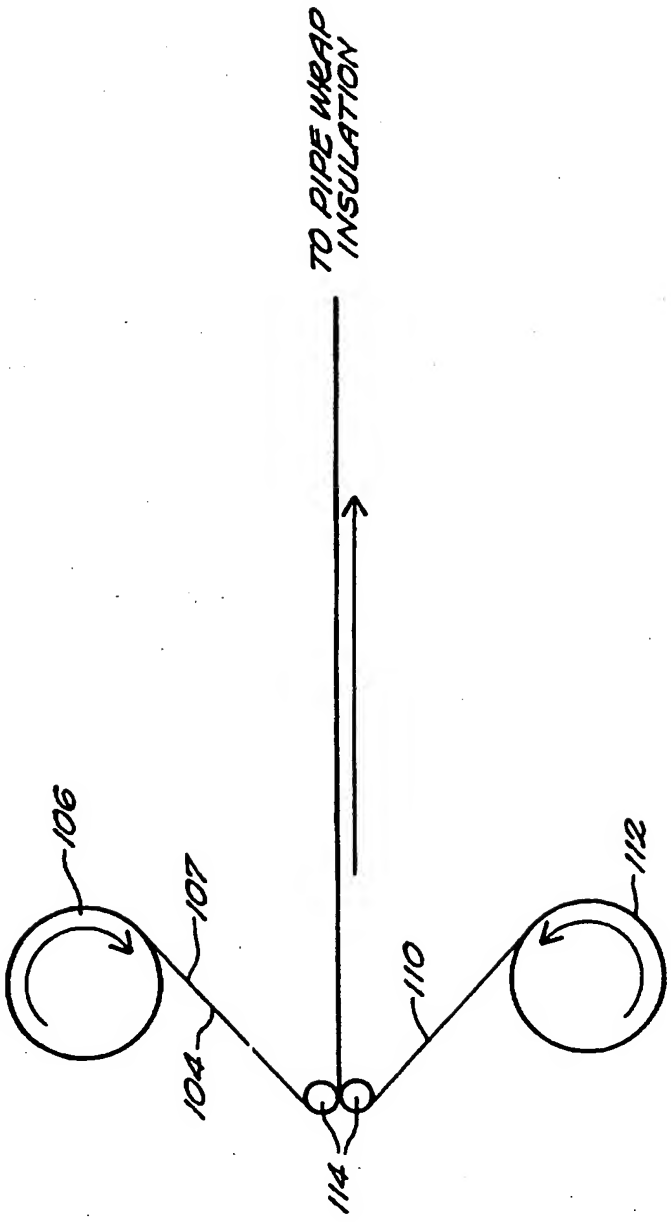

FIG. 5